Newberry (J. S.)

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with the kind regards of
J. S. N.

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REPORT

ON THE

STATE HOUSE WELL,

(Columbus. O)

BY

J. S. NEWBERRY.

(From Report of Superintendent of State House for 1860.)

REPORT ON THE STATE HOUSE WELL.

BY J. S. NEWBERRY.

Wm. A. Platt, Esq., Superintendent of State House:

SIR:—In compliance with your request, I have examined the record kept of the State House well, and the series of borings taken from the different strata passed through; on which I herewith submit the following brief report:

As you are aware, our only guides in an attempt to construct a section of the rocks passed through in boring such a well, are the register of the progress made, and the physical and chemical properties of the materials brought up in the sand pump. The accuracy of the classification attempted will depend, therefore, upon the care with which each change of structure in the rocks penetrated has been noted; and the degree to which the borings of the different strata have been mingled together in the pump. The register has evidently been kept with great care, and the indications of the thickness of the strata penetrated furnished by it may, in most cases, be accepted with confidence. The mingling of the borings is to some extent unavoidable, and there is a probability that the thickness of some of the beds has been from this cause, slightly exaggerated, or diminished; the highly colored layers imparting their tints to the borings of the next succeeding ones; and where no marked difference of texture exists the line of separation has been obscured, and the upper bed unduly thickened at the expense of the lower. The gradual fading out downward of the deep red of the shale struck at about 880 feet shows, I think, a mingling of the borings of that stratum with those of the upper part of the great mass of greenish calcareous shale below. Here we are liable to overrate to some extent the thickness of the red stratum. The crumbling of the shale in the great bed to which I have referred, has caused portions of it to be mingled with all the borings taken from a lower point. Fortunately, the shale falling from above was not liable to get under the bit of the drill; hence it remains as distinct fragments in the borings of the sandy limestone below, from which it is easily distinguishable and separable.

It should also be mentioned that the series of boring shows a hiatus from the depth of 150 to 242 feet; a strong water vein having carried away all the materials excavated throughout this interval. The same may also be said of the last 200 feet bored.

For the purpose of bringing the entire subject at once and distinctly before the eye, I have prepared the following abstract from the register kept of the progress of the work since its commencement, and from it have constructed the succeeding

table showing the probable geological position of each of the more important strata passed through.

Synopsis of the Register of the State House Well.

Date.	No.	Thickness.	Depth struck.	Rocks passed through.	Feet bored per day.	Remarks.
1857. Nov. 4	1	123	.....	Clay, sand, and gravel.	....	Well tubed with 6 in. iron pipe to the rock. Inside of this is a 4 in. pipe sunk several feet into the rock.
Dec. 2	2	15	123	Blackish shale.	7	.....
Dec. 11	3	138	138	Gray limestone, with bands of chert.	5	Struck current of water at 150 feet, which washed away borings to 242 ft. Found sulphur water at 180 ft.
1858. Jan. 14	4	2	276	Very gritty rock.	2	Water raised 5 ft.
Jan. 15	5	486	278	Limestones, light colored and sandy above, darker and argillaceous below.	10	Found salt water at 675 ft.
Mar. 20	6	162	764	Red, brown and gray shales and marls.	12	Borings salty.
Apr. 8	7	1058	926	Greenish calcareous shales.	13	Progress per day ranging from 1 to 25 ft.; much impeded by crumbling of shale. Strata harder below. Borings salt.
1859. June 25	8	475	1984	Light colored sandy magnesian limestone.	4½	Water continues saline.
1860. June 21	9	316?	2459	"Whitish sandstone." (Calcareous.)	4	Probably alternating bands of sand and lime above. No borings preserved below 2,570 ft.; mostly washed away by water.
Oct. 1	....	....	2775.4	Present bottom of well, in sand rock?	....	.....

Geological Section of the Strata penetrated by the State House Well, Columbus, O.

No.	Thickness.	Character of Rocks.	Their probable geological equivalents.	
1	123	Clay, sand, and gravel.	Alluvial and drift deposits.	*Drift.*
2	15	Dark bituminous shale.	Base of Hamilton group.	*Devonian.*
3	626	Drab and gray limestone, with bands of chert; sandy above; darker, and argillaceous below.	Cliff limestone of Ohio. Upper and lower Helderberg, and Niagara groups of New York.	*Upper Silurian.*
4	162	Red, brown, and gray shales and marls.	Clinton group, Medina sandstone.	
5	1058	Greenish calcareous shales.	Hudson River group. Trenton, Bird's-eye, Black River, and Chazy limestones.	*Lower Silurian.*
6	475	Light-drab sandy magnesian limestones.	Calciferous sandstone of N. Y. Magnesian limestone group of Missouri.	
7	316	"White sand rock." (Calcareous.)	Potsdam sandstone.	

It will be seen from the preceding section, that somewhat different views are suggested in reference to the geological equivalents of the strata passed through in boring the well, from those advanced in the very interesting report made by Prof. Mather, in 1859. The limestone group, number 3, of the section, was regarded by Prof. M. as representing the entire "Cliff and Blue limestones," while the red and green shales below, Nos. 4 and 5 of section, were supposed by him, to form a group of rocks, nowhere exposed within the limits of the State, and such as had not before been suspected to exist in our geological series. The further progress of the work has, however, revealed new facts in regard to the order of succession in our sedimentary strata, which throw more light upon this subject, and, as I think, now permit us to determine, with a good degree of certainty, all the *generalities* of classification of the rocks underlying the central portion of the State.

I say generalities because it is evident that we yet want the data for determining all the nicer questions of the parallelism of this series of rocks with those of the other States of the Union. The State House Well has given us a most interesting glimpse of their lithological characters and relative thickness, but it is well known that fossils alone furnish reliable guides for the determination of the ages of rocks, and for the accurate limitation of formations; and from the well no fossils have been procured, or at least preserved.

It must be confessed too, that we have as yet a very imperfect knowledge of the

details of the geology of our State, as exhibited in the exposures of its rocky substrata on the different portions of its surface. A large part of our territory is yet wholly unstudied, and there is almost none which has been carefully examined in the light of modern science. Both east and west of us the succession of strata has been worked out with great care, and most interesting revelations of the history of our continent and its animated occupants have been drawn from a comparison of the rocks of New York and Pennsylvania, with those of Iowa and Missouri, Kentucky and Illinois.

Between these widely separated districts, Ohio lies geologically almost a *terra incognita*, and the scientific world is looking forward with much interest to the time when this, the keystone of the geological arch spanning the interval between the Alleghanies and Ozarks, shall be lifted to its place, and thus complete our continental symmetry. Until this desired knowledge shall be obtained, any classification of the strata penetrated in the State House Well, must be regarded as only provisional and liable to future modification. The evidence in favor of the arrangement suggested in the preceding section, will perhaps be best given by considering each group in its order.

No. 1. "Clay, Sand and Gravel."

No accurate register was made of the relative proportions and positions of the different materials, composing the superficial deposits in this well, nor, so far as I can learn, were any specimens of them preserved, and it is therefore impossible to say how large a part of this series, 123 feet in thickness, is true Drift, and how much local, or valley drift. From the wide area in this region occupied by similar beds, it is probable, however, that the greater portion of this mass represents the true Drift.

As is usually the case, the gravel beds beneath the State House, are saturated with water, and if they had not been severed by the valley of the Scioto from their connection with those of the somewhat higher land west of Columbus, it is highly probable that water would have flowed frem them over the surface.

No. 2. "Blackish Shale."

This is merely the edge of a conspicuous member of the geological series in Ohio, called the "black slate," by the members of the former geological board. It is a mass of more or less bituminous shales, having in Adams county, according to Dr. Locke, a thickness of 251 feet. In the northern and north-eastern part of the State, where it is extensively exposed — forming the lake shore for 200 miles — it is considerably thicker. It is usually quite bituminous throughout, containing in the aggregate as much carbonaceous matter as the entire coal series, but no distinct beds of coal. It is a member of the Devonian or Old Red Sandstone system, and lies between the Waverly sandstone and the Columbus limestone; both of which may be classed in the same great formation.

This has hitherto been considered the least important, economically, and least interesting of all the rocks of Ohio; yielding neither fossils, building stone, nor any useful minerals. Recent developements, however, have rendered it probable

that a large part of the rock oil, found so abundantly in the northern part of the State, is derived by spontaneous distillation from the carbonaceous matter of these shales. In New York, the Hamilton group, of which this formation is apparently our only representative, has a thickness of 1,000 feet. As we shall see in our examination of the lower rocks, this marked diminution, in thickness, is only part of a great systematic change in the volume of all rocks, composed of mechanical sediments — such as sandstones and shales — observable in going from the eastern to the western States; a change following a departure from the place of the shores of the ancient land, from the erosion of which these clays, sands, &c, were derived.

No. 3. "Drab and Grey Cherty Limestones, sandy above, darker and slaty below."

This limestone group is subdivided by Prof. Mather, into five parts, viz: 1. Columbus limestone, 138½ feet thick. 2. Gritty hard rocks, 2 feet. 3. Buff limestone, 22 feet. 4. Blue limestone, light and dark, 277 feet. 5. Limestone shale, 187 feet. Of these he regards the upper 115 feet as "Cliff limestone," the balance, about 500 feet in thickness, as the equivalents of the "Blue limestone' group of Cincinnati. This was perhaps the most natural view to be taken of the case at the time Prof. Mather's report was written, but the subsequent discovery of the magnesian limestone and massive sandstone far below, plainly, as it seems to me, the "Calciferous" and "Potsdam" sandstones, has required a revision of that classification, and has explained the apparent anomaly, of the great mass of underlying argillaceous shales. If, as I have supposed, the yellow magnesian limestone is the equivalent of the Calciferous, then the thick mass of greenish calcareous shales and limestones, which rest upon it, correspond to the Trenton limestone, Hudson river group, &c. And since we have abundant palaeontological evidence, that the exposed portion of the Blue limestone series of Cincinnati, is the equivalent of the Hudson river, and not of the Niagara group, we cannot suppose, that any considerable portion of the Cincinnati series, is represented in No. 3 of our section; that limestone group lying much too high, and being too thin to justify such a supposition.

The view I have suggested, is confirmed by other considerations. Since it is conceded that the Blue limestone series of Cincinnati, represents the Hudson river group of New York; in the Cliff limestone group—if we include under that name, all the rocks which fill the interval between the summit of the Blue limestone and the "black slate" — we shall have in that group all the representatives found in Ohio, of the fifteen distinct, simple or compound, rocky masses which occupy the same interval in New York and Pennsylvania. These are in descending series the *Corniferous limestone, Onondaga limestone, Schoharie grit, Cauda-galli grit, Oriskany sandstone, Upper Pentamerus limestone, Encrinal limestone, Delthyris shaly limestone, Lower Pentamerus limestone, Waterlime group, Onondaga salt group, Niagara group, Clinton group, Medina sandstone and Oneida Conglomerate.* These strata, in western New York, have a thickness of over 3,000 feet.

The only detailed section of the rocks which in any part of Ohio fill this interval is that contained in the carefully elaborated report of Dr. Locke, on the geology of Adams county. He there found, between the Black slate and Blue limestone—

1. Cliff limestone..... 89 feet thick.
2. Marl.....106 " "
3. Cherty limestone..... 52 " "
4. Marl..... 25 " "

Below this the Blue limestone series, 1,000 ? feet thick.

It further appears, from observations made at different points in the western part of the State, that the members of this Cliff limestone group are very variable in thickness, and in lithological characters, and that in their aggregate thickness they occupy a considerably greater vertical space than where examined by Dr. Locke. We know also that the marked diminution in thickness in the New York rocks enumerated above, in tracing them westward, is progressive, and is necessarily less in Central than in Western Ohio. Existing in such force as they do in New York and Pennsylvania, it seems impossible that at Columbus they can have shrunk to a less volume than I have assigned them in Nos. 3 and 4 of the preceding geological section.

It will be seen at a glance, that an attempt to compress into the 626 feet of our No. 3 the entire Cliff and Blue limestone groups—strata which occupy fully double that space at Cincinnati—a point where one might expect them to be considerably thinner than at Columbus—involves difficulties which seem to be well nigh insurmountable. In addition to this, that theory would make of the underlying rocks an anomalous and enigmatical group, without equivalents, so far as now known, in the geological series of the Mississippi Valley.

No. 4. "Red, Brown and Gray Shales and Marls."

In New York and Pennsylvania, below the Niagara, and above the Hudson river groups, is a series of rocks about 1,000 feet in thickness, composing the *Clinton Group, Medina Sandstone* and *Onedia Grit.* Of these, the last is lowest, and equal in thickness to the other two combined. It is a coarse conglomerate, which soon thins out and disappears toward the West. The Medina Sandstone is a compound mass, consisting of sandstones, shales and marls, of which the prevailing color is red. The Clinton Group is also made up of variagated shales, limestones and sandstones, much thinner than the Medina, and so variable in character as to be sometimes styled the *Protean Series.* Both these owe their red color to the presence of iron; and the Clinton Group embraces a rich and peculiar stratum of fossiliferous iron ore, which is recognizable at numerous localities, not only in Pennsylvania and New York, but in Canada, on Lake Superior, in Wisconsin, etc.

Following the rule which holds good in reference to all other mechanical sediments, these rocks also thin out toward the West; and yet, even on the Mississippi, traces of them have been discovered. In Southern Ohio, and at Madison, Indiana, between the Cliff and Blue limestones, Prof. Hall has found what he sup-

posed to be the representative of the Clinton of New York. It was hardly possible, therefore, that we could fail to meet with some indications of these strata in the State House Well. Accordingly, the borings and the records give us evidence that between the Cliff limestone series and the shales which I have regarded as the equivalent of the Hudson river group, is a mass of red shales and marls, which may be, with considerable probability, regarded as their representatives. We cannot accurately determine the limits, vertically, of these shales, nor, without fossils, draw any sharp lines of geological classification, but they form a marked feature in the section—marked both by their color and composition—containing more iron and silica than those above or below them. Occupying such a position, and of such a character, till further evidence shall be brought to bear upon their place in the series, I should be inclined to regard these shales as the equivalents of the Clinton and Medina rocks of New York; here, like the associated strata, more calcareous, and less sandy, than at their eastern exposures.

No. 5. "Greenish Calcareous Shales."

It seems to me that we can scarcely doubt that this series, which is more than a thousand feet in thickness, is the equivalent of the Hudson river and Trenton groups of New York. This is indicated by its lithological characters, its thickness, and its relative position, resting, as it does, on the yellow magnesian limestones. On this supposition, the section afforded by the State House Well corresponds in all its general features with the geological series described by the geologists of Pennsylvania and New York, of Canada, Wisconsin, Iowa, Missouri and Tennessee, while any other view which has suggested itself to my mind leads only to inextricable confusion. In New York the strata immediately succeeding the Calciferous sand rock, in ascending order, are—

1. Chazy and Black river limestones .....100 feet thick.
2. Trenton limestone.....400 " "
3. Utica slate .....100 " "
4. Hudson river group.....700 " "

In Pennsylvania the thickness of the Hudson river group alone is estimated at 6,000 feet. This group consists, at the East, according to Prof. Hall, of green, blue and red shales, shaly sandstones, and some beds of limestone; and has been traced through to, and beyond, the Mississippi. In Missouri, Professor Swallow reports the Hudson river group to have a thickness of 120 feet, while the Trenton limestone below is 360 feet in thickness; the latter resting upon the great Magnesian limestone series—the equivalent of the Calciferous sand rock—which has a thickness of more than 1,000 feet. Attaining such enormous development, as the rocks immediately above the Calciferous do in Pennsylvania, one might expect to find them forming a conspicuous feature in the section of the State House Well. We might expect, too, that the lithological character of our representatives of that group would show a marked diminution of sand, and an increase in the relative quantity of lime; all of which conditions are satisfied by the calcareous shales, No. 5 of our section. These shales are over 1,000 feet in thickness, are very soft

and argillaceous above, harder and more calcareous below, and, unless we include a portion of the overlying red shales, are of a greenish or bluish tinge throughout. As before remarked, the evidence that the hills about Cincinnati are composed of the equivalents of the Hudson river group, is such as to fully satisfy the able palæontologists who have examined that district; and there is perhaps now no one who questions the truth of their conclusions. The strata which more accurately represent the Trenton and Black river limestones, etc., may therefore be supposed to lie still lower, and, for the most part, beneath the Ohio, and the whole to form a group of calcareous shales and limestones, as estimated by Dr. Locke, 1,000 feet in thickness. As far as lithological characters are concerned, there would seem to be the greatest possible similarity between the Blue limestone series of Cincinnati and the calcareous shales under consideration. When comminuted, as are the borings from the well, the one can hardly be distinguished from the other by the eye, or chemical test. Fragments of these shales of considerable size were also frequently brought up in the sand-pump. These, too, are undistinguishable from fragments of the "marls" or calcareous shales of the Cincinnati series.

No. 6. "Light Colored Sandy Magnesian Limestones."

A marked change of material seems to have been encountered in the well at the depth of 1984 feet. Here, and suddenly, the shales in which the workmen had so long been boring were passed through, and the auger struck into light colored sandy limestone. The records shows that this continued with little variation to the depth of 2459 feet, when "white sandstone" was struck; this continuing without interruption to the depth of 2608 feet, when there is an entry of "sand and lime." Thence to the close of the register there is no record of the character of the material passed through.

In the series of borings preserved I find no indications of a very decided change of structure in the rock, below the Calcareous shales. At first sight all the material brought up in the sand-pump from below this point would be called a fine yellow sand. Under the lens it is found to consist of angular fragments of a crystalline rock, nearly pure white in color, with here and there brown ferruginous particles, which give to the mass a brownish or yellowish aspect. When treated with acids these borings all effervesce freely, and the portion of insoluble silica remaining is often comparatively small. Magnesia is also contained in all, or most of the samples examined, and we have therefore evidence that the greater part of the rock from which borings were obtained below the shale series, is a yellow magnesian limestone, of which all portions are more or less sandy. This rock I am disposed to regard, as has been before stated, as the equivalent of the Calciferous sand rock of New York, and the "Magnesian limestone series" of Missouri. With the western magnesian limestones it has much in common, both in appearance and composition; and were we able to lay open this member of the series in Ohio we should probably discover that the change observable in the Calciferous sand rock, in going from New York to Missouri was, like the others already noticed, progressive in character; and that here it presented an aspect intermediate between the eastern and western extremes.

No. 7. "White Sandrock."

As has been stated in the preceding section, no evidence is furnished by the borings preserved, that any purely silicious rock has been penetrated. Those brought up from the depth of 2460 feet—one foot below the point where a "white sandstone" is said in the register to have been struck—are like those taken from above, highly calcareous; indicating rather a limestone than sandstone. Below this point they become more decidedly sandy, though still including a large per centage of lime; which may, however, have been derived from the overlying strata. Between 2500 and 2570 feet—the lowest point from which any borings were obtained which are preserved in the collection—all the material taken from the well is a fine brownish-white sand, including to the last a notable quantity of lime. At 2502 feet a current of water was struck which carried off all the borings for some distance below. This seems to have recurred subsequently, as nothing was procured by the sand pump nearer than 150 feet to the bottom of the well. The indications are therefore, that when the progress of the work was arrested, the auger had penetrated deeply into a thick bed of sandstone lying below the Calciferous sandrock, and that the two formations are not separated by any strongly marked line, but gradually shade into each other. Such we know to be the relation frequently sustained by the Calciferous sandrock to the Potsdam sandstone. This is especially true at the West, where in many localities they are so thoroughly blended as to be entirely inseperable.

As is generally known, the Potsdam sandstone lies at the base of the fossiliferous series, and includes what are supposed to be the first forms of life which existed on our globe.

Probabilities of obtaining water by further boring.

However interesting in a scientific point of view the information gained of the succession of strata underlying our State may be, this, in itself, will scarcely be regarded as an equivalent for all the labor and money spent in sinking the State House Well. The object in prosecuting the work has constantly been an eminently practical one, to obtain water. A far more important question, therefore, so far as the public is concerned, than any yet considered, remains to be answered, viz: Will water be procured by going deeper? To this question I think all who have carefully examined the register kept of the strata penetrated, and are at all familiar with the rationale of Artesian Wells, will agree with me in saying that it is impossible to give a very encouraging answer; for the following reasons.

1st. The geological structure of Ohio is not favorable to the general success of experiments of this kind. Our rocky sub-strata lie in unbroken sheets, with a gentle and nearly uniform dip in one direction; showing no marked disturbances, by which ridges, troughs, and basins have been formed, that, when the water-bearing strata are pierced, should produce a flow above the surface. The great lines of

upheaval to which we might look for a supply of water derived from a higher level than that of our general surface, are so remote that their influence can scarcely be depended on. It may be anticipated, therefore, that over the greater part of our territory disappointment will be the rule and success the exception.

2nd. The Well has penetrated a succession of both porous and impermeable strata, alternating the one with the other. Through several of the former strong currents of water were flowing, but in no case did it rise to the surface; and finally when, after many months of constant labor, the auger was driven through more than 1000 feet of fine argillaceous shales, wholly impervious to fluids, striking into thick beds of sandy rock, evidently saturated with water, conditions as favorable to success as any we could reasonably hope for were attained without the accomplishment of the object in view. While then it is by no means impossible that by sinking the Well to a greater depth some stratum may be reached from which water will flow to the surface, it would seem that the probabilities are not in favor of it.

Judging from the records kept of the Artesian Wells bored at St. Louis and Louisville, water was obtained in both from strata holding a similar relative position (probably geologically the same) with those penetrated near the bottom of our well. It seems probable, therefore, that our want of success is not dependent on any defect in the texture of the strata passed through, but rather in their more nearly horizontal arrangement; there being near us no arch, or uplift, from which they descend in such a way as to give the water flowing through them the requisite "head."

There is another consideration which has a bearing on the propriety of continuing the work, and that is: in case it should happen that a stratum were penetrated at a greater depth, from which water would flow over the surface, that water would almost certainly be highly saline in character—perhaps possessing valuable medicinal qualities, but probably not pleasant and heathful "drinking water." Doubtless it would supply—more or less perfectly—the want of water about the State House and grounds; as the use of water there will be in a great part mechanical; but there is scarce any requirement that it would supply equally well with pure water. As a consequence, there would still be needed a large importation, from some other source, of the fluid which is a vital necessity both to the animal and vegetable world.

There is no question that an abundant supply of good and pure water can be obtained, by pumping, at a depth of 140 feet; and probably within 100 feet of the surface. The cost of raising it that distance may easily be estimated. The experience of those engaged in raising salt water, rock oil, &c., in the different parts of the State, proves that, aside from the necessary machinery and reservoirs, the actual cost of raising 2,000 barrels of water per day from the depth of 140 feet would be something like $600 to $700 per year; or, should it not be necessary to keep the machinery running the entire year, about $2 50 per day while it should be in motion.

TEMPERATURE OF WELL AT BOTTOM.

Should water be procured from a point below where the boring ceased in the well, it would be nearly "blood warm," as proved by the experiments of Prof. T G. Wormley. When the well had been sunk to the depth of 2,575 feet, Prof. W. tested the temperature of the bottom, with the following interesting result, which I give in his own words :

"A Walferdin's thermometer, placed in a glass tube, filled with water, and this enclosed in a strong iron case, also filled with water, was lowered to the depth of 2,475 feet, where it remained for twenty-five hours. It was then sunk to the bottom of the well, a depth of 2,575 feet, where it remained for forty minutes. Upon the withdrawal of the instruments, it was found to have registered 88° F. Assuming this to be the temperature at the bottom of the well, and also assuming as correct data that the temperature is uniformly 53° F. at a depth of 90 feet, we have an increase of 1° F. for every seventy-one feet."

The same rate of increase would give for the present bottom of the well (2,775 feet from surface) a temperature of about 91°.

Very respectfully,

J. S. NEWBERRY.

CLEVELAND, Nov. 1, 1860.